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DOWLER

PHYSIOLOGY



147

# CONTRIBUTIONS

TO

## PHYSIOLOGY.

BY

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A power to direct the operative faculties to motion or rest, in particular instances, is that which we call the *will*.—LOCKE.

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To SAMUEL CARTWRIGHT, M. D.,

Distinguished as a Philosopher, honored as a Physician, admired as a Man, this essay is most respectfully inscribed, by

THE AUTHOR.

*New Orleans, October, 1849.*

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III.—*Contributions to Physiology*. By BENNETT DOWLER, M. D., of New Orleans.

THE experimental researches now offered to the reader's attention, originated incidentally, during a course of anatomical examinations made upon the great saurian of Louisiana; examinations which have corrected numerous prevalent errors, and which have at the same time resulted in discoveries that are deemed important, if not fundamental, in their bearings upon the doctrines of physiology; none of which, however, are essential to the purposes of this paper, and, therefore, need not be given now. For anatomical, rather than for physiological reasons, my vivisections have been chiefly confined to the alligator; an animal whose anatomy, physiology, and psychology place it above frogs, turtles, and salamanders, which have been generally relied on by experimenters. How unlike soever the alligator is to man, these latter are more so. If frogs are good, alligators are better. Indeed, Dr. Carpenter, a distinguished physiologist, expressly declares that "experiments on the nature of this (the nervous) function, are *best* made upon the *cold-blooded* animals; as their general functions are *less disturbed* by the effects of *severe injuries* of the nervous system than those of birds and mammals."—Phys. §375.

It will be borne in mind, that vivisections have been ever restricted to the inferior animals. Man never has been subjected to physiological dissection, though this had been a merciful process compared to many methods of torture, which, in former times, were adopted by the State, but more particularly by the Church; times in which, unfortunately, physiology had no more an existence than liberty.

Hence, the point of departure here taken, whether impregnable or otherwise, is, according to usage, the legitimate one. The method of determining function, by vivisection, is bad; yet, where can a better be found? The biologist is reduced to the sad alternative of remaining in a great degree ignorant, if he reject all methods not directly demonstrative. He reads in an artificial condition, a natural condition; in a part, the whole; in analysis, synthesis; in decomposed forces, compound forces; in vital maelstroms, cataracts and *crevasses*, the smooth, noiseless, equable, and ever-flowing river of life; in concentrated agony, the concentration of animal happiness, that is, the laws, perfect health; in an incomplete death, he takes his lesson upon the complete science of life. Like the tempest-tossed Columbus, in search of the new world, he finds here and there drifting fragments from the mysterious realm—now a light! land! and, like the enraptured mariner, chants *Gloria in excelsis*.

As, then, the method of exploration, by vivisection, never has been, never will be extended to man, its processes must be restricted to the inferior animals, and its results must be applied on the principle of analogy. There can be no doubt that seeing, hearing, motion, pain, and the like, are similar in man and animals, though, from the imperfection and the *limited number of our senses*, we are unable to appreciate fully any of these phenomena in either class. Perhaps, the great difficulty in physiological research, lies in the *limited number of the*

*senses*—ten or more senses may be necessary, instead of *five*, or sometimes four, or three, as with the deaf and blind. The experimental favors this transcendental view. For example: is there not a need for a *dynamical sense*? Say, O, groper in the dark! what do you know of the number, nature, and substrata of the forces, as the muscular, capillary, voluntary, involuntary, vital, chemical, electrical, magnetical, calorific, gravitative, planetary, mental? It is highly probable that a *sense* of this nature would enable the physician to cognize disease as an entity! It is remarkable, that even those physicians who deny disease to be an entity, nevertheless think, speak, and write of it, as if it were really such throughout pathology and morbid anatomy. Is frontal pain, red eyes, yellow skin, black vomit, or pale liver, yellow fever *itself*, or are these *effects only*? If a physiological fact be many-sided, or have, say, eight links, all of which must be known in order to make it really valuable in practice; and if our cognition can reach only to four aspects or links, this half knowledge may be as useless as the odd half of a pair of scissors. It is here, if anywhere, that "a little learning is a dangerous thing."

We have no sense by which to appreciate space in its entirety. The senses, and the experimental philosophy may reckon by inches, miles and leagues, but they never can reach, much less teach, the infinite expansion, which pure reason cognizes, as an essential truth in relation to space—an intuition seen in its own light, and as it were, in contrariety to experience, or antithetically. "The progress of Astronomy," said Laplace, "has been a constant triumph of philosophy over the illusions of the senses." The mind as an entity, connected with or separate from matter, cannot be identified, appreciated, or even conceived by the existing senses of man, notwithstanding his irrepressible desires and efforts, hopes and fears in relation to this part of his nature.

The same want is obvious in what are called Final causes, including the essential conditions, connections, adaptations, and ends of physical, mental and vital phenomenology. The sense of *Finality* might enable us to apprehend the connection between quinine and the dissipation of an intermittent, between chloroform and insensibility, mind and body, gravitation and matter. The adaptations and the intentions of nature are, in a considerable degree, obvious in the osseous, muscular, dental and visual structures, while those of the brain, nerves, spleen, capillaries and other organs are beyond the grasp of the senses. Nor, is this all. Causes produce effects, apparently contrary to all analogy and synthesis. The muscular motion produced by the percussion of the dead body, is exactly contrary to every principle of dynamics known in the physics of inert matter. The percussed body does not move in a right line, nor in a direction opposite to that of the percussing force. In the following experiments, all the physical stimuli applied to decollated alligators, are answered, not in the language of physics, but in that of physiology.

The phrenologist, as well as the biologist, pursues this route, namely, comparative anatomy, throughout the entire realm of the animal kingdom, from the lowest type to the highest, in order to prove that the brain is the exclusive organ of the mind—a theory, which some of the following experiments oppose; for the headless trunk of an alliga-

tor, deprived of the supposed organ of combativeness, displays a good will to fight, using both its limbs, directing all its available means intelligentially, and, upon finding, *after a fair trial*, that these fail, it retreats laterally, by rolling over *from* its enemy, never *towards* him, as if guided by sight—all of which the sequel will prove.

The clinical method of physiological research is of vast importance, but its results are less satisfactory than many suppose. It is less simple than vivisection. A lesion in a particular tissue or organ, may be—nay, often is—only the effect of composition of causes; the common product, to which several organs, tissues, and functions have contributed equally. Hence, that vast accumulation of clinical facts, to which many appeal, in order to prove some of the prevailing doctrines of physiology, is, in this connection, often of doubtful import. Many of these facts admit of a different interpretation; or, at least, do not clearly warrant all the conclusions which have been drawn from them, particularly as to sensational, intelligential, motory, spasmodic, tetanic, convulsive, maniacal, inflammatory, adynamic, paralytic, and febrile phenomena. The nervous masses constituting the cerebro-spinal, and ganglionic systems, have been divided, subdivided, named, mapped, described, and gravely inaugurated into all the offices of the living economy, to the exclusion of the other tissues and organs, whose *roles* are equally important in the system.

The style and terms used by neurological writers, are startling. They talk of double filaments of nerves throughout their entire course—the one set for sensation, the other for volition—as if these were anatomical facts; they affect to point out motory and sensory tracts, as if they themselves could see these in the very act, very plainly; they insist on what they call the *true spinal marrow*, which they claim as a discovery, though they do not pretend that any anatomist, of the material school, can either see it, or feel it, except in diagrams, in books. Mr. Solly discourses of “the neucleated *dynamic vesicle* connected with the *motory and sensory tracts of the cerebellum*,”\* and Professor Walshe, of the University of London, with due hesitation, speaks of “the *mere dynamic change of the spinal cord*.”†

The pedantry of some of these, and of many other terms recently introduced into the physiology of the nervous system, differs from the specimen invented by Coleridge, inasmuch as these terms are totally incomprehensible: A learned man, instead of asking his wife to make the tea, told her to add to *quant. suff. of thea chinensis*, the oxyd of hydrogen saturated with caloric! Mr. Lamb, having been asked for a definition of what is called learning, replied, that it was a systematic arrangement of ignorance—a very good definition of innervation, reflex action, sensory tracts, motor tracts, afferent, efferent, excito-motory, not to mention those wonderful maps, charts, topographical surveys, and diagrams with arrows pointing out all the highways and by-ways, not of neurological lands, but of the reflex travellers themselves.

About three or four years ago, it will be recollected by the readers of the London Lancet, that there was a learned correspondence among

\* On the Brain, 262.

† London Lancet, July, 1849.

some of the most eminent physiologists of England, in which it was seriously asserted, that the human brain was arranged in strata and sub-strata; one stratum was devoted to politics, another to sciences, another to religion, while others performed less dignified duties, such as calling for medical advice. It was, also, affirmed that these strata were very liable to dislocation! Such dissolvent scenes are wonderful, especially in the nervous system. It is not a little surprising to find so many physiologists, charmed by a glittering word INNervation, an ideal creation, an ideal alteration, never yet discovered, never yet explained even transcendently, and, consequently, beyond the reach of verification by any materializing test, beyond the scrutiny of Realism. *This word*, however, serves as the foundation of much in physiology, more in pathology and therapeutics, and, what is still more astounding, it is relied on by some morbid anatomists. The latter, finding that in almost all persons dying of what disease so ever, particularly of fever, that little or no appreciable alteration takes place in the nervous tissues or matter, concludes, against both reason and analogy, that their patients die of innervation, or an unknown change in that structure! Would an angler go into a rail road car to fish?—a recruiting officer into the dead house for soldiers?—a gold digger into a glacier?—an astronomer into the mammoth cave of Kentucky?

The theoretical bias to centralization which prevails in modern physiology is not warranted either by the experimental, nor the transcendental philosophy. Why should not the sensorium be *diffused*, instead of being *restricted to a single centre, or mere point* in the cranial, spinal or abdominal cavity? Why should all the lines of intellection, sensation, motion, and vitality meet in, or radiate from, one or three centres? For example: take any organ associated with the sympathetic system, and compare it with any ganglion of that system, and it will appear from anatomy, analogy and teleology, that the organ is better adapted to do its own work than the ganglion, though both may be necessary to the origin and perpetuation of the organic function. The same bias prevails in pathology. Affections of the nervous centres are spoken of with as much confidence, as if they were cutaneous affections. What would be said of a diagnostician, who would pronounce a disease, *itch, or erysipelas* without *any alteration* whatever in the skin? "Ignorance is bliss," to such knowledge of organs, functions, diseases and morbid anatomy.

How little is positively known of the anatomical characters of mental diseases? The celebrated Esquirol, in his elaborate work—*Des Maladies Mentales*, concludes that post mortem examinations do not reveal the seats of mental diseases; and that these diseases do not always take their point of departure from the brain, but often from other parts.

The pathological or clinical method of investigating the functions of the nervous system, is not only too difficult in itself, but too vast for the narrow scope of this inquiry. For example, many cases of the disorganization of the brain, by disease and accident, might be given, wherein the psychological and motory functions persisted almost unimpaired. Vivisection, though a different method, affords similar results. One of the densest of all absurdities in physiology and pathology, is that of attributing all unexplained and incomprehensible facts and doctrines

to the nervous system—that Hades of theory, “Where the wan sceptres walk eternal rounds.” According to the testimony of experimentalists, favorable to the paramount claims of the nervous system, it would seem, that the blood is equally potent with the nerves.

Prof. Muller quotes and adopts the conclusions of vivisectioners, namely, that “the muscles loose their power of *motion* when the current of arterial *blood* towards them is obstructed. This phenomenon is sometimes observed when a ligature is applied to a large arterial trunk in the human subject; the power of moving the muscles under the influence of the will is either partially or wholly lost, until the collateral circulation is developed. This fact has been confirmed by Arnemann, Bichat and Ernest. Segalas has also observed that, when the *abdominal aorta is tied* in animals, the hind legs are rendered so weak, in *eight or ten minutes* they can scarcely be dragged along. Whether the principal influence of the *blood* consists in its maintaining the contractility of the muscles, or in its enabling the nerves to convey the influence of the will, has not been investigated.” (Phys. 658.)

In opposition to some of the doctrines of the present system of neurology, including its absolutism, its supposed centralization, and its exclusive pretensions to psychical, phrenological, dynamical, sensational, volitional, pathological and vital domination, it might be urged and proved, synthetically and analytically, that often other systems or tissues contribute equally, sometimes surpassingly, to the economy, in health, and in disease: for example, observation, experiment, analogy, teleology and ratiocination prove that muscular motion is not the mere passive, but the direct act of the muscle—not a mere secondary, transmitted nervous force, but an inherent, ultimate phenomenon, which, in its simplest state is quite independent of the nervous centres and their connections. This is, indeed, remarkable; for it may be confidently predicted, from what is already known, or from what may be fairly deduced from data extant, that future researches, impartially conducted, will show, that each tissue, each organ contributes to the vitality or life of the whole; or, (to use an apt illustration, for which I am indebted to my distinguished friend, Dr. Cartwright,) as each State of the Union is, for certain purposes, sovereign and independent in itself, and, yet, contributes, at the same time, together with all the States to form one general government, so each organic tissue contributes to the formation of one vital whole. The constellation is fixed: No State revolves around another, or even around the general government. There is not one centre, and thirty satellites or organs in either the Federal, or in the physiological system. Admitting (what is indeed positively erroneous,) that the nerves form an essential condition of muscular contraction, still this would not prove them to be the instruments of motion, seeing that they have no adaptations to that end, while the muscles have. Moisture, a certain temperature, and certain nervous influences might be necessary conditions, not direct agents adapted to flexion and extension.

Among the forces or dynamics of the living body, I regard two, as having been already established as independent and inherent, namely, the muscular and capillary, (including the venous, portal, lymphatic and lacteal.) At least, there can be no longer any question as to the reality,

independence and non-derivative nature of the former. Possibly, the latter may be only a modification of the same force—a force, that must serve, henceforth, as the type and point of departure for the science of Vital Dynamics. Can physiology boast, as yet, of any other clearly developed and well established dynamical principle?

The Forces, as *Forces* in their own essential nature, elude observation, altogether, being accessible only in their phenomenal character, that is, in their motions or laws, connected with material masses, time and space. The muscular force presents a lever, by which the physiological dynamist may work, namely, adaptation, which latter is in a great degree obscure or wanting in the capillary, venous and chylous organs. The motions attributed to the nerves, are not only gratuitous assumptions, but they are sometimes in absolute contrast to the principles of adaptation. There is not a nerve, teleologically speaking, that can compare with the muscular organs, as in flexion, extension, pronation, supination, or with the dynamical finality of that great muscle, the heart. The physicist, who examines the levers and muscles of the arm, has but a short step to take towards vital dynamics; but it is impossible, even after taking for granted that there *is* a nervous fluid, to advance in any direction, without getting more into the dark than ever. Here the best physiologist cannot advance by anatomy, nor by vivisection, nor by clinical observation. He may reject hypothetical fluids, and immaterial, dynamic alterations; he may appeal to morbid changes, and yet he shall make but little progress in explaining, even those diseases called nervous. Palsy, to take the strongest case in favor of the neurologists, may happen without any perceptible injury of the brain, cord or nerves. In sun-stroke, the only disease wherein there is *no trace* of either sensation, intelligence or voluntary motion, the nervous masses present no alteration, the lungs being the seat of the lesion.

In the London *Lancet* for July, 1849, it is reported, that in nearly every case of death from the inhalation of chloroform, the insensibility and the extinction of life take place in less than *one minute*, and that the only lesion found, is in the *lungs*. Now, in nearly all cases of apoplexy of the gravest character, the patient lives one or two days, and is rarely, if ever, *completely* insensible.

Far be it from me to *under-rate*, because others have *over-rated*, the *role* of the nerves in the animal economy. Both experiment and teleology discountenance the doctrine that all mental and material forces, including sensational and voluntary phenomena, originate solely in the brain, or in any three points in the cerebral, spinal and ganglial masses, and not in a diffused sensorium—a sensorium co-extensive with nervous matter—a sensorium limited only by the expansions of the living mass. The assumption of an end, and of the essential conditions or adaptations in structure to produce that end, upon an intelligible plan, all fail; teleology fails to support the present exclusive system of neurology. What are called the great discoveries in the nervous system during the nineteenth century deviate farther from the truth, if I may speak what I believe, than the researches of the last century, as revealed in the works of Whytt, Prochaska and others. Ascribe the great force manifested by the delirious, maniacal and the tetanic to the nerves, instead of the mus-

cles; grant the cramps in cholera, to the nerves, and not to the muscles; admit the same in the case mentioned by Haller, wherein a delicate girl affected with emprosthotonos sustained a weight of 800 pounds without straightening her body; concede all, and what will be gained or explained by thus sacrificing to an assumption, the evidence of the senses, of anatomy, of analogy, and of adaptation?

That the cerebral, spinal and ganglial masses are necessary to health and life, cannot be denied; the same may be affirmed of the heart, and its blood vessels, of the lungs, of the blood, of the muscles, and of many other tissues. But it does not hence follow, nor is it at all probable, that the heart's action, muscular contraction, the capillary motion, calorification, and many other functions that might be named, are exclusively or even principally due to the nerves. Evidence might be given, proving quite the contrary.

Before proceeding to the experimental portion of this paper, it is deemed necessary to give a brief outline of the principal doctrines, now received as fundamental in the physiology of the nervous system, so far as the following experiments may have a bearing on the same. This course is the more necessary, because some persons, particularly students, may desire to see these doctrines, and the experiments side by side for easy comparison.

"Between the brain and the muscles," says Sir Charles Bell, "there is a circle of nerves; one nerve conveys the influence from the brain to the muscle, another gives the sense of the condition of the muscle to the brain; *if the circle be broken by division, there is no longer a sense of the condition of the muscle, and therefore no regulation of its activity.*"\*

In the dictionary of Natural History by the principal savans of Paris, the following summary is given: "La locomotion s'exécute du moyen d'organes dont l'ensemble constitue l'appareil locomoteur. Cet appareil se compose des organes actifs et des organes passifs du mouvement. Les premiers sont l'*encephale* où réside la *volition* ou la *volonté* d'exécuter tel ou tel mouvement, les nerfs qui la transmettent aux *muscles* qui l'exécutent sous leur influence."†

Müller says, on the subject of "co-ordinate movements," that "the movements of locomotion are dependent on the *will*"; that "the *cerebellum* more especially rules over the combination of the muscular actions," and that "the *removal of the cerebellum* produces a *loss of all harmony in the action of the groups of muscles.*"‡

Müller maintains that the *associate or consensual movements*, "all have their source in the brain itself. Irritation of a portion only of a great nervous trunk never influences the rest of the nerve, but is propagated *only to those branches of it which are formed of the fibres irritated.* The associate movements cannot be ascribed to the sympathetic nerve."§

Professor H. Milne Edwards, says: "All parts of the spinal marrow and medulla oblongata lose the faculty of determining voluntary movements, and of giving birth to sensations, *as soon as they are separated from the brain.*"||

\* Nerv. Syst., 159. † ix., 447. ‡ Phys., 677. § Ib., 536. || Anat. and Phys., 160.

"The action of the *brain* is indispensable to the perception of *sensations* and *manifestation of the will*. The impressions received by the nerves, must be conveyed to *this organ*, that the animal may be *conscious* of them."\*

Mr. Solly, in his late work on the brain, says that "the nerves are mere conductors, not *originating* the power of contraction in the muscles, conducting a *something* to a certain point, [that is the brain,] where it is converted into a sensation and perceived"; and that "the *cerebellum* is a *regulator* and *co-ordinator of muscular action*."† All of which he affirms as true in comparative, as well as in human physiology.

Drs. Kirkes and Paget, in their recent manual of Physiology, say, "that the *cerebellum* is the organ for the co-ordination of the voluntary movements, or for the excitement of the combined action of muscles"; a view which they declare, "is confirmed by *comparative anatomy*," and, finally, "that *no other office* is manifest in the cerebellum than that of *regulating and combining muscular movements, so that the will be definitely and aptly directed to them*."‡

Mr. Alex. Walker, in 1815, maintained "that the *cerebellum* is the organ which gives impulse to *all muscular motion, voluntary and involuntary*"—(corrected in 1834, thus "to all *voluntary motion*.") "Sensation precedes, not only motion, but perception and intellect in conformity with the truth '*nihil in intellectu quod non prius in sensu*.'" "The *cerebellum* is the organ of *volition*." "This or that convolution [of the cerebellum] will give guidance to corresponding muscles."§

In the system of Physiology written by Dr. Roget, for the last edition of the *Encyclopædia Britannica*, it is laid down as an axiom, "that sensation does not take place, unless the part of the spinal cord to which the nerve is connected, communicates by an *uninterrupted continuity of substance with the brain*."||

In a learned periodical, (*Bibliotheca Sacra*), ¶ PROFESSOR CHACE, of Brown University, maintains, in his elaborate paper "on the dependence of the mental powers upon the bodily organization," that the brain is the only part of man related to the mind, to perception, sensation, voluntary motion; the spinal marrow being only a medium of communication for the brain; that "the *cerebellum* is *immediately* concerned in the regulation and subordination of the different *muscular contractions*," and that the removal of the latter renders an animal *incapable* of executing "with *any precision, movements requiring the combined and harmonious action of several muscles*"; all of which, the professor affirms, is at once true in man, and in the inferior animals.

Dr. R. B. Todd, an eminent and learned author, in a recent lecture on the physiology of the nervous system, concludes that the "spinal cord is incapable of *originating* any nervous action except in virtue of some physical change in it; it cannot develop any mental action except in

\* Anat. and Phys., 170.

† On the Brain, 259, 261.

‡ 322, 3.

§ Nerv. Syst., 284, 286, 400, 414.

|| xvii., 673.

¶ For Aug., 1849.

obedience to a stimulus from some of those *centres*, belonging to the *encephalon*.”\*

As there will probably be an attempt to explain the experimental portion of this paper by *words*, such as *instinct*, *automatic motion*, etc., it may be proper to allude to these terms.

The definition of *instinct* by the great Cuvier, and adopted by the eminent Muller, is subjoined—a cataract of assumptions it is. The natural history of Ossianic ghosts is less incomprehensible: “In order to have a clear idea of *instinct*, it is necessary to admit that animals have innate and perpetual images or sensations, which induce them to act as ordinary and incidental sensations commonly do. It is a sort of a dream or vision that ever haunts them, and may be considered, in all that relates to instinct, as a kind of somnambulism”†

Professor Muller, says “*instinct* is unknown to the animal,” “presenting to its sensorium the *theme*”; “is identical with the creative force of the organization”,—“first manifested in the sensorium.”‡

This author designates *automatic movements* as “all those muscular actions which are not dependent on the mind, and which are either persistent or take place *periodically*, with a *regular rhythm*, and are dependent on *normal natural causes* seated in the nerves or central organs of the nervous system. The cause of the *rhythmic movements* may be either in the sympathetic nerve or the great nervous centres, but *never in the mere cerebro-spinal nerves*.”§ The popular or common definition of this word is strictly mechanical;—the motion indicated is similar to that caused by a watch-spring, by a weight, by steam, by gunpowder, and the like.

It can hardly be expected that psychologists will accept, with alacrity, the conclusions deducible from the following experiments, so hostile, to the prevailing doctrine of the mind. Indeed, Professor Carpenter of England, has, in advance, pronounced upon the facts to be offered—he has, in effect, declared against their possibility, because, they are in conflict with psychology: He says, a frog can perform voluntary actions after the division of the spinal cord *only in that part of the body above the division, that is, next the brain*, the latter being uninjured; while, that part separated from the brain acts involuntarily. His argument is this: “To say that two or more distinct centres of sensation are present in such a case, would be in effect the same as saying, that there are two or more *minds* in one body,—which is manifestly absurd.”¶

Suppose that an alligator is in perfect health, with the exception of a loss of sight, and a loss of the power of forward motion, could it give any clearer indications of sensation and voluntary motion, than those mentioned in these experiments as occurring after capitation?

The following experiments are offered without any view to arrangement, as being adapted to prove particular doctrines. The applications are left to the reader.

Sept. 8th, 1849.—*Experiments on the Alligator*.—Dr. S. Powell, of this city, witnessed all, and aided in most of these experiments: this account was written the same day, and was read to, and approved by him.

\* New York Jour. Med., Sept. 1849. † An. King. ‡ Phys. 676. § Ib. 664. ¶ Ib. 877.

A longitudinal incision in the neck, from above, was made through the thick mass of muscles upon the cervical vertebræ—the vertebræ and the spinal cord were divided completely; the finger was passed between the divided parts. In about three quarters of an hour after, a transverse incision was made midway between the shoulders and hips—the spine, with the cord, was divided with the saw, the parts were separated so as to admit the finger between the divided ends of the cord, exposing the abdominal cavity. In about half an hour after this second division, the animal was placed on its back, and the whole of the viscera were slowly dissected, and removed from the body. The sympathetic was destroyed. This last dissection occupied about one hour. During the latter part of this process, and some time after the removal of the organs, the animal died, having lived after the first section, about two and a half hours.

During a period of more than two hours, this animal displayed complete intelligence, volition, and voluntary motion in *all divisions of the body*. It saw, heard, felt, defended itself, showed anger, fear, and even friendly attention to its keeper, a black boy. This latter manifestation, is so extraordinary in an alligator, that I will notice it first, though it was not verified, until after the second division of the spinal cord. This animal, with several others, were presented to me, by my friend, Dr. Young, when leaving this city, to visit Europe, during the last summer. Mr. Barbot (at whose apothecary store this animal had been kept, with the others, for many months) informed me, some weeks ago, that it had become fond of the black boy, who had taken care of it. The experiments had lasted more than an hour—the animal had been much exhausted—had lost much blood, and, for a time, scarcely seemed to take notice, when Mr. Barbot proposed to bring up to the third story his servant, its keeper; the boy went near it—he called it in a kind of gibberish style—it raised up its head and turning towards him, gently opened its mouth—looked quietly at him without its usual menace. All four of the gentlemen then present, agreed that it recognized the boy, and that it manifested affection for him. The boy repeated his fondling calls (gibberish) several times, and with the same results. It saw him, followed him with its eyes, and knew his voice. Its mute language could not be mistaken. It was the first time I had seen affection of this kind in alligators. I have kept some nearly a year. They always feared, or menaced me, though I always fed them. For nearly two hours, the animal watched our operations: on approaching too near it, so as to excite its fears, it raised its head, opened its mouth to bite, directing its head to the right or left, to attack its enemy. It threw the nictating membrane over the eye, on perceiving a body approaching near the cornea, in order to defend the same; and this, too, in advance of actual contact. It retained the sense of hearing: for on making a noise by striking a board, without advancing towards the head, it looked angry, and opened its mouth to bite.

In the meantime, the other parts of the body (though its spinal marrow was divided in two places,—in one severing most of the muscles of the back) manifested sensation, volition, and combined or complex motions of a vigorous character. This was not all. For, the lateral

museles of the body not divided, together with the hind legs, were adapted so as to aid the forelegs in removing fire, or a pricking body, *above the part divided*. In fact, the forelegs and hindlegs, mutually aided each other, notwithstanding the *intermediate division of the cord*.

After nearly two hours spent in this kind of experiment, it was found on dissecting the viscera, and sympathetic, the animal lying on its back, that it directed its limbs to the place where the knife was applied in dissection.

The heart continued to act as long as it was observed, even after having been roughly handled, emptied, and removed from the body.

For want of suitable instruments to divide the spine, the vertebræ were injured, and the muscles were extensively divided, which, of course, diminished the brilliancy of the results.

Have not vivisectioners vitiated the results of their experiments, when they have cut the muscles, and the great levers, the bones, without which the phenomena of motion cannot take place even in a physical point of view? In the longitudinal dissection of the spinal cord, to get at the roots of the nerves, the bones and muscles are cut and destroyed, which ought not to be done. I have seen a healthy woman who had, from a neglected fracture, a false joint, midway between the shoulder and elbow, the arm hung powerless, by her side, like a dead weight. She could perform no voluntary motion with it, simply, for want of a lever or bone, as a *point d'appui*. Vivisection, for the roots of the nerves—(and this is the great physiological passion of the age) is, often, for these merely physical reasons, the fruitful source of false theory.

If the spinal cord be viewed as a *double organ*, a longitudinal dissection of its canal, in order to reach the roots of the nerves, must be regarded as a very equivocal mode of experimentation, both physiologically and mechanically, since, it is, as already mentioned, *destructive* in its nature; or, at least, it must completely derange the equilibrium of the osseous, muscular, and nervous tissues. A transverse section of the cord and of its soft and bony envelopes, is, both functionally and physically, a simpler experiment than longitudinal dissections. The influence, long attributed to the spinal serosity, in sustaining muscular motion, affords an example of erroneous experiment and rationation. By the proceedings of the Academy of Sciences, at Paris, it now is admitted, as proved by M. Longet's experiments, reported in 1845, that the disturbance, and the loss of muscular motion, are owing, not to the subtraction of this spinal fluid, but to the antecedent destruction of the bones, muscles, and the like, in the opening of the spine. A violin with all its strings and frame work divided, and placed in the hands of a dead man, could hardly be expected to discourse in good music.

October 30th, 1847.—*Experiments on an Alligator, nearly three feet long*; by Dr. Young, Mr. Barbot, and myself:—Five grains of strychnine were dissolved—half of which was thrown into the gullet—a small portion was regurgitated; in twenty-five minutes several convulsive contractions took place in the general muscular system. The residue of the mixture was now given;—a portion was again rejected—the convulsive contractions increased—tetanic rigidity followed—the

jaws forcibly closed—the limbs became stiff and straight. In one hour after taking the first portion of strychnine, the animal appeared nearly dead—there was only an occasional motion on the hind legs, tail, and in the nictating membrane. Dr. Young now began to dissect the animal, with the view of preserving its head, and skin. The limbs had ceased to be rigid, and were sometimes directed intelligentially. The spinal cord was severed in the neck,—a probe passed down the spinal canal two or three inches below the part giving off the axillary plexus, breaking up the texture of the cord completely; one spasmodic jerk followed in the forelegs, on introducing the probe. For an hour after destroying the cord, the forelegs contracted, though far less frequently, less forcibly, and less definitely, than the hind legs and tail. The heart for three hours, that is, as long as observed, acted regularly, both before and after its removal from the body.

April 13th, 1848.—At 10 A. M., I observed an alligator, *in articulo mortis*; (its health had been declining for some days, owing to an inflammation of the bowels with ulceration, as the post mortem examination showed;) it was unable to walk, but watched my movements. In fifteen minutes afterwards, it appeared to be quite dead. It was placed on its back for dissection; it moved its limbs intelligentially for several minutes. The dissection lasted seven hours; during nearly half of this time, the heart or ventricles continued to beat about fourteen times per minute—the right auricle, about twice as often. The heart was separated from all its annexæ, but did not cease to act, until after its ventricles had been roughly probed. Thus freed from blood, and removed from its connections with the nerves, it acted with regularity, as before.

May 12th, 1848.—Having observed that an alligator had become feeble, I determined to kill it for dissection. On taking hold of it, it seemed much alarmed, and cried several times, Houpe! Houpe! This is the only articulate sound that I have ever heard from an alligator, and it is, I believe, peculiar to the young animal, and is never uttered but when danger is suspected; it appears to be the synonym of the word *Help*, the sound of which, it very much resembles. It hissed, and attempted to bite.—The upper portion of the skull, including a horizontal stratum of brain, was removed. Hæmorrhage, to a considerable extent, followed; the eyes closed. The animal no longer attempted to bite. It performed, however, a series of voluntary motions, intelligently directed, to ward off injuries. The entire brain and the medulla oblongata were removed, without diminishing its power to direct its limbs to any part that was pained by the slightest touch of a pin or knife. A metallic rod was passed many times within the spinal canal, completely destroying the spinal marrow beyond the hips. The animal appeared to die very soon, the tail excepted. It was, however, afterwards found, that both voluntary motion, and sensation, remained, though their manifestations were greatly impaired. The forelegs were slowly and feebly directed towards irritated parts; these motions disappeared in a very few minutes. The tail twitched frequently, for an hour after, as if pained by the dissection of the trunk, and viscera. Both before and after its removal from the body, the heart acted regularly for four hours. The right auricle was the first to collapse.

May 22d, 1848.—Dr. Young, and myself, (aided by Mr. Barbot,) performed the following experiments, upon a stout alligator, four feet long. Two men drew several strong twines with all their strength around the animal's neck, but this, in ten minutes, did not produce either strangulation, or palsy, though the force of the limbs was diminished. Decapitation was now performed. The great carotid, which threw out blood freely, was tied after three or four ounces had been lost.

For more than an hour after decollation, sensation, perception, vision, passion, and voluntary motion continued in the head. It saw its enemies—opened its mouth to bite, at the proper time—nictated, when a foreign body approached the eye. The pupils responded, naturally, to the degrees of light.

The headless trunk for three or four hours, during extensive mutilations by two operators, manifested, in a still higher degree, sensation, intelligence, definite, well directed muscular actions. There was, as usual, a complete loss of progressive or forward motion. The tests used to elicit sensation, and voluntary movements, were pinching, puncturing, and burning. Its sensibility and motions appeared to be nearly as acute, quick, and varied, as in the unmutated animal. The direction of the limbs was not such as could be deemed habitual, as in walking and swimming. Some of these motions are of difficult execution in the entire animal, from its anatomical conformation; such as reaching up between the shoulders or hips, to remove an irritant. All of the muscles that could in anywise contribute to the will and aims of the animal, as in curving the body or tail, so as to bring the irritated part within the range of the appropriate limb, etc. There was not a single unmeaning or convulsive motion. These motions, altogether volitional, began, continued, and ended with the pain producing cause. For hours, during the dissection of the viscera, the limbs, when unconfined, were directed in this intelligent manner. While operating on the organs connected with the sympathetic or ganglionic system, these motions were less vigorous and less frequent, than those noticed during operations on the periphery. It was necessary to tie the animal on its back, during the dissection, to restrain its intelligent motions.

The heart remained *in situ*, nearly four hours; in the meantime, all its annexing vessels had been severed—its associated organs removed, without destroying its pulsatory action, which, in four hours, declined from 36 to 16 per minute. It was roughly handled; its blood emptied out; it underwent pressure and considerable desiccation, but was still active when the observations ended. On other occasions, I have observed the continuous action of this organ, for seven hours, proving that the favorite assumption of physiologists concerning the blood, as being the necessary stimulus to the heart's motion, is an error. There is a simpler explanation, namely, the inherent force of that hollow muscle itself.

June 5th, 1848.—Dr. Young, Mr. Barbot, and myself, performed the following experiments on an alligator three feet and seven inches in length, occupying a period of seven hours, during the greater portion of which, these gentlemen were constantly present. The animal was not very vigorous. It had a congenital mal-formation or deficiency,—

or, what is more probable, it had been early in life, mutilated by which, the entire tongue, and the whole flooring of the under jaw, were removed. The skeleton of the lower jaw was covered with a thin, white, dense membrane, all the soft parts having been removed. The animal was emaciated, and highly anemic; its blood was thin and pale, owing, doubtlessly, to the difficulty of catching and swallowing food, in the absence of the tongue, and the flooring to the under jaw. The animal was decapitated, and the great artery of the neck was ligated. On touching the lid, the eyes closed. It bit when a stick touched its teeth. On passing a wire into the foramen magnum, and breaking up the brain, these actions ceased. The sensational, intelligential, motory and volitional phenomena of the trunk, were the same as in the cases already described. About one hour after decapitation, a wire was passed down the spinal canal beyond the hind legs. By repeated manipulations, the texture of the cord was completely disorganized. The vigor and promptness of its intelligential motions were greatly impaired, but not wholly lost. During an hour after this destruction of the cord, punctures, or fire, caused slight motions of a definite character, like those before decapitation, but not constantly. The contractions of the heart were 48 per minute. The intestines, seven hours after decapitation, and five after removal from the body, presented, as usual, contractile phenomena, of a peculiar character.

August 20th, 1849.—*Experiments on two alligators; each about three feet long.* [Circumstances, not necessary to mention, prevented me from taking full notes, at the time of these vivisections. Doctors Cartwright, Smith, Nutt, Powell, Hire, and Mr. Barbot, were present, together with several gentlemen not of the profession—among whom was Professor Forshey.] The alligator, No. 1., was tied down on its back. The trachea was ligated in the middle of the neck. No blood was lost. The incision was closed with stitches, and strips of adhesive plaster. The animal was returned to its den, where it was found, apparently dead, about half an hour after. I proceeded to dissect the viscera for a few minutes, when, at the request of Mr. Forshey, (a learned and able cultivator of science,) the ligature was removed from the wind-pipe. The latter was opened. A tube was introduced into the opening. The lungs were repeatedly inflated by Mr. Forshey. The animal was, thereby, soon restored to life. I proceeded to demonstrate the viscera, and to remove the organs. After this was done, (which occupied about two hours,) the animal ceased to show any signs of sensation, or voluntary motion. It lived, after the ligation of the trachea, a much shorter time than decapitated alligators. The heart, both before and after its removal from the body, maintained its contractile motions, as long as observed, that is, for three hours. The apparent death from the tying of the trachea, in so short a time, was a result that I did not expect, because, I had often taken what I supposed to be effectual means to ascertain whether these animals breathed, when left undisturbed, but I never could detect them in the act of breathing, though, when alarmed or angry, they hiss and blow almost constantly. Baron Humboldt says, from personal observation,\* that they live two or three days without respiration at all—*sans respirer de tout*.

\* Diction. Decouv. t. iv. 226.

In this experiment, the animal did not appear to suffer but little, immediately, from the ligation of the trachea. Before the removal of the ligature, and the inflation of the lungs, life seemed quite extinct—the limbs relaxed—the body supple and motionless. If my recollection be accurate, the *incipient dissection*, (that is, before pulmonary inflation), did not elicit any sensational, or volitional phenomena. If this be so, (and it is worthy of being tested by experiment), it would seem that this form of death is more complete, than that by decapitation. After the latter operation, however, the removal of the lungs does not interfere with the phenomena, as already narrated.

*Experiments on the alligator, No. 2*: (The same gentlemen, as before mentioned, were present:) The decollation was not followed by a projecting stream of blood, as is usual; no ligature was applied to the great artery of the neck. The dull hatchet used in severing the spine of the neck, had probably bruised the artery as in torsion and gun-shot wounds. Hence the hæmorrhage was not great, though considerable.

I carried the handle of the knife towards the eye, to ascertain whether it would wink, whereupon the ferocious, separated head, sprang up from the table with great force, at me, passing very near my breast, which received several drops of blood; it alighted upon the floor, from six to eight feet distant from its original position! It missed me, because I was standing at the side, and not in front of the head. Although, I have examined carefully, all the muscles of the head, I cannot find one that accounts for this feat of combative muscular motion. The angles of the mouth recede so much in this animal, that after decollation, including the medulla oblongata, the head seems almost like two separate pieces, the superior and the inferior maxillary bones, being joined chiefly by the great masseter muscles, for only a short distance. These great muscles, (the masseters), which are curved, having their concavity anteriorly, are adapted only to vertical action, as in biting—the great muscles of the tongue act backward and upward against the palatine region:—whence then this quick, violent, forward motion, or rather, as in this case, diagonal leap of six or eight feet—for the head deviated to the left, where I was standing, evidently with the intention of biting me? The trunk, in this, as in all cases, possessed no power of forward motion. This curious fact with respect to decapitated animals, noticed by M. Magendie,\* and other vivisectioners, has been attributed to the *loss of the cerebellum*; but whether this loss of forward motion in the alligator, be owing to a division of the spine, and great muscles, or to the separation of the larger or smaller brain, or both, is not very evident, yet the fact which I have noticed respecting the forward motion of the separated head, is, perhaps, a circumstance favorable to this view. That a voluntary, spontaneous and powerful motion,—in fact a diagonal leap, should be performed by the separated head, must therefore appear astounding to one acquainted with the muscular organization. It is difficult to understand, how the cerebellum could thus act alone.

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\* Magendie says "Ce que j'ai remarqué jusqu'ici de plus constant, c'est que le cervelet semble nécessaire à l'intégrité des mouvemens en avant." (Jour. de Phys.)

For about two hours, the headless trunk of the last mentioned alligator, exhibited such phenomena as are usually attributed to the brain, namely, sensation, volition, and intelligent motion, as tested by the application of bits of ignited paper, wounds, and the like, whereupon, the usual indicants of pain were elicited with great promptness and precision: it trembled, receded, rolled over, curved, placed its limbs accurately to the exact spot, and removed the offending cause. In certain places this was exceedingly difficult, as on the spine between or near the shoulders, or hips. It always used the limb the best adapted for the purpose. If the fire was too remote, as when applied to the tail, the whole body was thrown into the most favorable position, for the purpose of reaching, and removing the same. If the fire was placed on the table, in a position to annoy, yet without touching, the animal, as if endowed with sight, reached, and always accurately, to the exact spot, and either extinguished the fire, or removed it. As upon former occasions, if the animal found that the fire was continued at the same spot, and that it could not remove it, which was sometimes the case, owing to continuous, or repeated applications, and carefully manœuvring, it curved the body—scratched violently, manœuvred skillfully, and then as a last resort, rolled quite over, laterally, always *from*, never *towards* the fire and operator.

After these experiments had progressed for some time, Dr. Cartwright desired me to cut off the neck close to the shoulders. This was done, but the intelligent, sensational, and volitional motions continued as before.

These experiments, not to name others on alligators, and a vast many made on human subjects soon after death, clearly prove that the fundamental principle of the reflex doctrine, is erroneous. For, according to this doctrine, even convulsive, unmeaning, or involuntary motions, can not be effected, except by irritating some portion of the *particular arc of nerves* distributed to the *particular part or limb to be moved*. Thus, galvanic, or other irritation of the spinal nerves distributed to the forelegs, could not affect those sent to the hind legs, but must be reflected precisely, from that portion of the cord, whence the nerves originate. Just the contrary, of this mechanical theory is true; for a lighted match applied in the course of the cervical, dorsal, lumbar, or sacral arcs, will call into play muscles and motions of an adaptive character throughout the entire muscular system, including the caudal extremity, which latter will be curved, if necessary, to the animal's purpose, while, in many cases, both the fore and hind legs will, in common, be called into active requisition. The fundamental doctrine of reflex physiologists, namely, that any portion of the muscular system must cease to have contractility, when the corresponding part of the spinal cord is destroyed, cannot be true. In his vivisections upon the roots of the spinal nerves, Magendie says that no effects were produced *except in the limb to which the bundle of nerves is distributed*: "Quand on coupe a la fois un faisceau de racine posterieure, il se produit un mouvement de totalite dans le membre ou le faisceau va se rendre."\* It is difficult to see how physiology can rest on such unmeaning experiments. It is no wonder

that Sir Charles Bell closed his life, by *abjuring such experiments*, though it is now *naively* said by his friends, (!) that he did wrong in this, as it destroyed the foundation of his supposed discovery of the double functions of the nerve-roots.

The destruction of the cord after decapitation is, it must be confessed, a quick method of destroying what is popularly called life, and with it nearly all voluntary motion; but this destruction in the human subject, at least, leaves the elementary contractile function for hours unimpaired. These functional motions, as flexion in the arm, do not act blindly, irregularly, convulsively, but respondent to appropriate percussions, *without being influenced by the integrity, or destruction of the spinal marrow and nerves*—a fact totally subversive of the reflex system.

Dr. Marshall Hall expressively says, that the *destruction* of the spinal cord prevents "*all contractile phenomena; the limbs become relaxed; are no longer obedient to stimuli; become perfectly flaccid; lose all their resiliency; the sphincters loose their circular form; become lax, flaccid, shapeless, &c.*"\*

As yet, I have not been able fully to elicit in the alligator, that variety of post mortem contraction, which I have described as belonging to the human subject—contractions, functional, and appropriate to the muscles percussed, but, doubtlessly, always without sensational or volitional. These forces, and their dynamical laws may differ greatly. Is it not probable, however, that man, soon after decapitation, would display phenomena similar to those in an alligator for a short period? Historical accounts could be referred to, showing that the lips of decapitated persons have uttered whispers, or manifested motion like that of a whisper.

Dr. M. Hall maintained with the greatest pertinacity, as the very foundation of his system, that sensation and volition belong exclusively to the brain; that "the presence of the medulla oblongata and spinalis is necessary to the contractile function of the eyelids, the submaxillary textures, the larynx, the sphincters, the limbs, the tail," &c., and that decapitation prevents all *voluntary* motion, even in the heads of animals. He insists that all motions after decapitation are reflex, involuntary, and without sensation, and that the distinguishing test of this excitomory system is, that "*the motions are always excited—are never spontaneous,*" as if voluntary motions were not excited, too. "By excited motions," Dr. Hall means, motions excited by contact, pinching, &c., and that *contact* is necessary in *all cases*. Now, I cannot answer for the English turtles upon which Dr. Hall experimented chiefly, but I will say, that the decapitated crocodiles of Louisiana can, *without contact*, wink, open their mouths, and even leap towards their enemy, though, of course, the *blind trunk* cannot see how to do all this anterior to contact. Indeed, under such circumstances, motions *anterior to contact* would be regarded *involuntary*. The separated head displays, at the same time, both voluntary and involuntary action. Sight and touch both are informers or exciters of volition, while the action of the iris, of the heart, intestines, &c., are, as in the unmutilated animal, *involuntary*.

Dr. Hall, and his followers, glory in this piece of logic, as the grand-est of the excitomory system, namely: that all excited muscular actions are involuntary! This system, discussed and entombed in the last century, disinterred and adopted in the present, rests upon this monstrous assumption, which can only apply to motions wholly physical, as action and reaction, by contact. Dr. Hall, who grows more and more solemn in his meditations upon this supposed discovery, concludes, in a late number of the *Lancet*, his paper on "*trachelismus*, and its *reflex action*," and modestly upbraids the present, and hails the wiser, purer, and brighter Future, thus: "I am," says the Doctor, "quite aware that neither the professional nor the public mind—they are *indeed nearly on a par*—are raised sufficiently for views so rational. But, then, *I do not write for the present day*; and the day will come—and I shall promote its advent."

Dr. Carpenter, an admired physiologist, is deeply imbued, not to say enamored, with the reflex logic, particularly that part of it relating to these *excited actions*. He says, that "the actions performed by the spinal cord, are of a purely *reflex* nature—consisting in the excitement of muscular movements, in respondence to external impressions, without the necessary intervention of sensation.\* Dr. Carpenter is sorely puzzled by the movements in a decapitated frog, which retracts its limbs, &c., when irritated. He denies that there is any feeling or volition in this case, "because such an inference would be inconsistent with other facts"—he ought to have said, theories. "These movements," he says, "are all *necessarily* linked with the stimulus that excites them. An animal thus circumstanced, may be not unaptly compared to an *automaton*; in which particular movements adopted to produce a given effect, are produced by touching certain springs."† Now, the phenomena which I have described are, in every particular, an absolute contrast to Dr. Carpenter's exposition—not "in *respondence* to external impressions"—not "*necessarily linked* with the *stimulus* that excites them"—not "*automatic*"—not such as "take place by touching certain *springs*." That logic has reached its utmost dilution, in assuming that there can be no volition in these phenomena, "*because* such an inference would be *inconsistent* with other facts." What law of merely automatic, or physical mechanics, or dynamics, is not palpably opposed to these phenomena? Is not physical motion uniform—*rectilinear*—opposite and in proportion to the stimulus or impressing force? Is the action and reaction equal in contrary directions?

The same author maintains, furthermore, that even these automatic movements, when the cord is divided, "do not exhibit any *consentaneous motions*" in the parts above and below the division, and that "the *same stimulus will always produce the same movement*." The whole of this enumeration is, if I may judge, erroneous. Dr. Carpenter is led into all these difficulties by the word *stimulus*, not being able to see how an act excited by a *stimulus* can be voluntary—I am still more puzzled to see how it could be anything else. I knew a blind man, very choleric and very stout, who was a great bully, and generally whipped his enemies severely, but he never was able to tell

\*Phys. §875 † Ib. §876.

his enemy by instinct, nor automatically, without a *stimulus*, as contact, or the sound of the voice. I adopt the method of reasoning directly opposite to that of Dr. Carpenter. If a decapitated frog act without a *stimulus*, the action is, probably, an involuntary, or a foolish one. What action of a rational man is not due to a *stimulus* of some kind—be it honor, wealth, pleasure, or pain? A *stimulus* is, according to Webster, “a goad; something that rouses the mind; as the hope of gain is a powerful *stimulus* to labor.” Is it possible that any right thinking physiologist can assert that the application of a bit of ignited paper to the headless trunk, by which all the above described actions are elicited, must act *automatically or physically, without the intervention of sensation and volition*? Can the imagination conceive any stronger proofs of feeling and willing, especially in a deaf, dumb, and blind animal, that has, moreover, lost the power of rectilinear progression?

As decapitation removes all the organs of the special senses, the trunk cannot see, hear, taste, nor smell. Stimuli adapted to these senses, must be inoperative, unless they are, at the same time, suited to the general sense, that is, to the touch of the sentient trunk. This latter cannot act so as to develop voluntary motion, without contact; but there is nothing whatever, in this sort of contact, which is suited to the generation of mechanical or automatic motion. The force or stimulus of steam, or gunpowder, does not give boilers or guns, subsultus, cramps, convulsions, or lock-jaw, much less understanding, volition, or voluntary action. Dr. Fordyce, upon the subject of muscular contraction, says, “The original motions are produced by volition, ideas of the mind, or certain *external applications, called stimuli*.”\* Thus decapitation (I must repeat the statement) deprives the trunk of four out of the five senses. The sense of touch only remains. How the reflex physiologists, or, indeed, any but sciologists, could expect, what they call *spontaneous or voluntary motions in the trunk, without a stimulus or contact*, is passing strange, not to mention the ineffable absurdity of construing the motions arising from a stimulus or touch, as involuntary. Blumenbach has truly said, that “the touch which is affected by external objects, is less fallacious than the rest of the senses, and by culture capable of such perfection as to supply the defects of others, particularly of vision.” (Phys., § xiii.) The blind require the stimulus of raised or salient letters, in order to read; but are these excited actions, and all the mental phenomena hence arising automatic, involuntary, excito-motory? The horny, scaly skin of an alligator, strange as it may seem, has an exquisiteness of touch, but little short of that enjoyed by “the snowy hands of a delicate girl,” to use Blumenbach’s comparison.

An infant has not the skill that a decapitated alligator has in removing a pain-giving irritant. A child puts its finger into the flame of a candle—a crazy man eats a glass bottle with fatal effect—a patient makes many awkward attempts to reach the instrument while under the process of trephining. In the alligator, after decapitation, the same stimulus does not always produce the same identical, mechanical motion as in an automaton, but *varied*, yet not convulsive actions. Sometimes

\* Elem. Phys., 103.

the animal uses one leg, sometimes both; sometimes it recedes by curving its body; sometimes by rolling over, and sometimes, by striking with its tail, while the separated head watches its enemy, and bites in the usual manner, not automatically, but for good reason, or what is the same thing, on account of a stimulus, as anger, contact, etc.

Anterior to *contact*, no one could expect in a decapitated animal, intelligent spontaneous action, upon either experimental, or transcendental principles. The stimulus of sound warns a blind man of danger, as on approaching the precipices of Niagara Falls—one blind and deaf, would step over the same fearlessly,—but, if conscious of the fact, he shall in his descent, lay hold of a limb, and remain air-hung and breeze-shaken, until his friends come to his relief, surely, his actions, stimulated by fear, must be regarded as voluntary. A headless animal performs actions essentially of the same kind. To call one class of phenomena *spontaneous* and *voluntary* and the other *involuntary*, or *excito-motory*, is a palpable contradiction to all experience and reason. The Reflex school takes for granted that all excited motions are involuntary; whereas, the opposite proposition is true, namely, that nearly all voluntary motions are excited, very few arising spontaneously, (to use a doubtful phrase)—few that do not arise from a present or prospective good—a present or prospective evil—a material want, or a material gratification.

Why should adaptation, contrivance, design, consentaneity, simple and compound motions go for nothing, simply because the animal has been so unfortunate as to lose its head, and all of its senses but one? Can a blind man see the rainbow?—a man without legs, dance the Polka? I incline to think, that the headless trunk has memory; for after the first irritations, like a burnt child, it dreads the fire, and makes increased efforts to remove the irritant, though it may be but a slight one.

If a stone were to manifest feeling, willing, contrivance, design and voluntary motion, that is, the elementary manifestations of mind, it follows, unavoidably, that this stone has a mind, higher or lower, it may be, than that of some other sentient beings. Now, if this stone be divided, and if each division displays essentially the same phenomena, it follows, that each has a mind, though this conclusion may not be a phrenological one; for the fundamental principle of the Gallian school is, that the brain is the exclusive organ of the mind; and, consequently, it is essential to mental manifestation, sensation, intelligence, volition in both human and comparative organizations—in both human and comparative psychology. Mr. Alex. Walker defines the mind wholly by the nervous matter: he says, "by mind, I mean the nervous functions common to man and animals."\* While M. Victor Cousin defines the mind by one of its faculties, thus: "The will alone is the Person or the Me. The Me is the centre of the intellectual sphere." Dr. Gall exclaims, "God, and the Brain!"

Mr. Solly defines the mind or its seat, as the cineritious portion of the hemispherical ganglion.

That such expositions should be made with all the confidence of

\* Nerv. Syst., 335.

demonstration, and be received with alacrity, is surprising. Even the monstrous technology of the reflex school, instead of retarding, seems to accelerate its progress, though history shows that neology, verbosity, pedantry, jargon and assumption, instead of being the characteristics of the era progression and discovery, choke up the pure stream of knowledge, and as in the dark ages, even prevent us from knowing our ignorance, by substituting barbarism for philosophy. Even the love of truth may, and often does lead into errors. The human mind, wearied with uncertainty, clings to any plank that drifts along within its reach. To rely on mere words is less wise. The mind delights in symmetry and strength, and having made up its bundle of opinions, joined with the cord of theory, it cannot draw out one, without weakening and deranging the whole.

Lest the first experiments in this series should appear "manifestly absurd," and too novel for belief, it may not be amiss to remind the reader, that Dr. Wigan, in 1844, published in London, an octavo, having for its title, "*The Duality of the Mind, proved by the structure, functions, and diseases of the Brain.*" Without going into the metaphysical arithmetic of the Duality, or Trinity of crocodilian minds—without affirming with the ancients that reptilians are types of wisdom, it may be asserted in a physiological point of view, that nothing is known of the mind, except through materialistic phenomena. Mind in itself, in its immaterialistic constitution, in its disembodied form, as a specific entity, distinct, and apart from matter, eludes physiological, phrenological and metaphysical research.

The diffusion of sensation and intelligence, together with a multiform volition, may be called by the physiologist, "a manifest absurdity," by the phrenologist, a manifest impossibility, and by the psychologist, a manifest blasphemy; but the experimenter may mutely point to a divided animal; one part on the right side of the table, manifesting intelligent motions, while on the left side, the other part manifests identical phenomena; both parts of the body, according to the exigencies of the case, acting voluntarily, but in different times, velocities, directions and modes. The "manifest absurdity" in this case, lies not in the multiform character of volition, but in the conclusion that all the manifestations of the head are mental, while the *same manifestations* in the trunk are only *anatomical, physical, instinctive*. But, even this distinction explains nothing, for there is as "manifest an absurdity" in *two instincts* as in *two wills*. The experimentalist may rest assured, that hard words, great names, and dazzling syllogisms cannot destroy palpable facts, nor produce physiological outlawry at this enlightened day.

Galileo, to escape the tortures of the Inquisition, was forced to swear that all his splendid discoveries of the planets revolving around the sun, were so many blasphemous heresies and lies, and that the solar system did not *move*; but an observer who was present, saw him stamp his foot on the earth, and heard him mutter, in a low tone: "IT MOVES, NEVERTHELESS!"

On the whole, it may be safely concluded, that voluntary motion is neither directly communicated from, nor regulated by the brain, or the cerebellum; that the muscles, in connection with the spinal marrow,

perform voluntary motions for hours after having been severed from the brain; that these motions are not only entirely independent of the brain, but may take place, though imperfectly, after the destruction of the cord itself; that the trunk, as well as the brain, thinks, feels and wills, or displays psychological phenomena; that the *sensorium* is not restricted to a single point, but is diffused, though unequally, or in a diminished degree, in the periphery of the body; and that actions which take place after decapitation, as described above, are in absolute contrast to *reflex actions*, being sensational, consentaneous, voluntary, and in other respects, dissimilar.

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#### IV.—ON THE *Topography, Climate, and Diseases of Selma, Alabama.*

*Read before the Alabama Medical Association, on the 7th and 8th March, 1849. By C. E. LAVENDER, M. D.*

THE town of Selma is situated on a high, sandy plain, on the north-west bank of the Alabama river, in lat. 32 deg. This plain, of a mile or more in extent, is much higher than the adjacent country that immediately surrounds it. On the west, Valley Creek, at the distance of one mile, makes its way through this plain, and finds its bed deep in the limestone formation, that underlies this whole plateau, at the depth of from 20 to 10 feet. On the north, at the distance of a mile from the river, the face of the country recedes and forms an extensive level of rich alluvial soil, interspersed with lagoons and marshes, till, at the distance of two miles, prairie soil, more undulating and diversified, sets in, and extends 3 or 4 miles to the low grounds of Valley Creek. On the east, the face of the country is almost a dead level, for 6 or 8 miles. Beech Creek, which comes down from the north-east, forks in its downward course, forms an island two miles wide and four long; this too, is covered, to considerable extent, with marshes. North and east of this swamp, the country is high and broken.

It will be judged at once, that such a location as this cannot be remarkable for its health. The changes which the face of this country underwent at its first settlement, some 25 or 30 years ago, were such as to create a perfect laboratory of miasm; immense quantities of vegetable matter, in a state of decomposition, being exposed to the action of heat and moisture. Bilious fevers, of an open remittent and intermittent type, followed in abundance. A successful system of drainage and culture has been in operation for some years past, which has rendered most of the circumjacent grounds dry and arable—soil inured to the sun, vegetable matter in a measure consumed, sources of miasm removed, and it is confidently believed that Selma is now one of the healthiest locations on the river. Indeed, for the last few years, it is questionable if a like number of inhabitants can be found any where, who have enjoyed better health than the citizens of Selma;

to such an extent is this true, that such a thing as the sickly season is hardly known among us.

With regard to temperature, it is doubtful whether there is, any where on this continent, a more even tempered and salubrious clime for the invalid or weak lunged, than this valley of the Alabama, taking the year round. During the summer, the mercury very seldom rises to 90 deg. in the shade, and in the winter, as rarely sinks below 30 deg. Shut out, by distance and immense forests, from the damp sea breezes of the gulf, it is yet fanned by the wing of the trades, so as to be delightfully pleasant during the summer. On the other hand, this valley lies so far to the South, and so distant from mountain ranges—those vast refrigerators of the north and west—as not to be visited in winter, with very great intensity, by those chilling blasts that prove so disastrous to weak lungs. Consequently, winter diseases—consumptions, pleurisies, &c., seldom prevail to any great extent here, and during the past winter have been almost unknown. True, pneumonia has prevailed to some extent here, in former years, but was not marked by high inflammatory symptoms, but assumed rather a typhoid type. There is a fact connected with location that is worthy of notice: that, during the whole year—but especially during the winter months—children suffer very much from croupy and bronchitic affections, whenever easterly winds prevail. These winds come down the river, and may be loaded with moisture. This fact, however, appears to me inadequate to account for the prevalence of these affections. The observation of 18 years' practice in this valley and the neighboring highlands, has established, in my mind, the fact, that an easterly wind, or rather a south-easterly wind—for it seldom comes direct from the east—is an unwholesome wind. In summer and autumn, it is freighted with fever, generally of the prevailing type, though it often adds to its malignant character; in winter, with croups and bronchitis; in the spring months, with exanthemata and influenzas. It is, all the year round, decidedly the most unwholesome wind that blows.

In the treatment of these fevers that prevailed in the early settlement of the country, depletion was carried to considerable extent. The lancet, tartar, calomel, &c., were freely tolerated; and were regarded, by many practitioners, as the most reliable and successful remedies. As the country grew older, morbid causes appeared to subside, or to assume a modified character. Change marked the features of the prevailing fevers, commensurate with the country's changes.

From the year 1834, to the present time, fevers assumed and have maintained a lower or congestive type; requiring a more stimulating and sustaining treatment. Although comparatively few cases of fever may properly be termed congestive, yet, there is a tendency in the type of fevers, generally, to run into that form; consequently, now, the lancet is never thought of, unless there exist some organic inflammation, in which case topical is, in our own autumnal fevers, preferred to general blood-letting,—and tartar emetic is very generally repudiated. Instead of these means, mild mercurial cathartics and quinine are now generally resorted to; and if there appear symptoms of congestion, camphor, brandy, and other stimuli, internal and external, are employed. Change in

the type of fevers, forced this change of treatment upon practitioners, often against their will, for they repeatedly witnessed the most disastrous consequences from the use of those means, which had, in former years, proved most successful. In all this, our country has not been singular. The history of most countries, indeed, proves that a change, in the prevailing diseases, takes place with the changing features of the country, as civilization advances. Looking to these lights, we may very surely expect to see still further changes present themselves, in the prevailing epidemics of coming years. An important pathological feature has, already, begun to develop itself. During the past year, well marked cases of *Typhoid Fever* have presented themselves. Some of these cases came under my own observation, and left no doubt, on my mind, in relation to their true character. No case of this type, however, has, to my knowledge, originated in Selma. A number of cases were brought to the place, all of which recovered. In Summerfield, a small village 9 miles north of Selma, some 20 or more cases occurred. These cases were confined to a few families, and to a circumscribed part of the village, where certainly no local causes could be pointed out, to account for the prevalence of typhoid fever. I saw some of these cases, and hope the Association will be furnished with a full report of this unusual and interesting visitation, by some one of the attending physicians.

Until within a few years past, this form of fever has been a stranger, or entirely unknown among us. Its existence has been acknowledged, however, in several places, in the great valley of the Alabama, within the last year or two, and, judging from its history, as it has presented itself in other countries and in other parts of the United States, little doubt can be entertained that it is destined, ere long, to be a frequent visiter among us, if, indeed, it should not be a prevailing form of disease. It is, therefore, a subject of vital interest to us at the present time. The eye of our profession should be fixed upon it, that its movements may be carefully watched, its features, in our latitude, clearly developed, and its advances met with appropriate remedies.

As regards the relative liability of races and sexes, to suffer from prevailing fevers, I beg to offer, as the result of my observation in this valley for the last 18 years, that whites are much more likely to be attacked, especially by fevers of a malignant character, than blacks; that mulattoes, in proportion to their number, suffer more and recover less promptly than either; and that males are more susceptible than females, and that deaths in males are at least two to one in females.

The limits of a report, like this, will not allow me to offer many remarks on the meteoric phenomena of the past year; nor do I suppose that I would be able to interest the Association by showing, to any very remarkable extent, their connexion with pathological developments.

The last week in May and the first in June were very hot and dry. On the 25th of May, I saw a well marked case of congestive fever. No case had ever presented itself to me before, so early in the season, by several weeks. The patient was a young man of good constitution, who had been bathing, and remained too long in the water, and was, therefore, in some sense, a case of *hydropathy*, the bathing acting, doubtless, as an exciting cause on a constitution predisposed to fever.



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